WTC COMMUNITY-LABOR COALITION COMMENTS ON EPA'S "DRAFT PROPOSED SAMPLING PROGRAM TO DETERMINE EXTENT OF WORLD TRADE CENTER IMPACTS TO THE INDOOR ENVIRONMENT "

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Respectfully submitted on behalf of the WTC Community-Labor Coalition by:

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to the
EPA WTC Expert Technical Review Panel

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Executive Summary

We are community, environmental, labor, tenant, religious, disaster recovery, small business, and social service organizations, residents, school parents, workers, property and small business owners in areas affected by World Trade Center pollution, who have been concerned about unaddressed environmental and public health issues since September 11, 2001. We have diligently participated in the World Trade Center Expert Technical Review Panel process since it began in March 2004. Our work as community and labor representatives in that process has been acknowledged on a formal basis by the Environmental Protection Agency (EPA) through the Community Based Participatory Research (CBPR) process.

On October 21, 2004, EPA published a revised version of the agency's, "Draft Proposed Sampling Program to Determine Extent of World Trade Center Impacts to the Indoor Environment" (hereafter, "Draft Proposed Sampling Program") in the Federal Register. In response to community and panel member concerns, the Draft Proposed Sampling Program extends the geographic boundaries for sampling to Houston Street, includes workplaces and public buildings, includes an expanded list of contaminants to be sampled, and eliminates air sampling (in favor of dust sampling). The improvements are an important step towards addressing the as yet unresolved problem of indoor toxic contamination caused by the September 11th attack on the World Trade Center and the aftermath of that attack. The WTC Community-Labor Coalition is also appreciative of the efforts of the EPA World Trade Center Expert Technical Review Panel for its role in helping to spur this progress. However, the Draft Proposed Sampling Program in its current form contains serious scientific and programmatic flaws which must be rectified in order for the plan to be scientifically valid, effective and credible.

Funded through EPA's CBPR process, we assembled a committee of highly qualified scientists and practitioners with expertise in environmental health, epidemiology, toxicology, industrial hygiene, statistical analysis, chemistry, and atmospheric transport and modeling. The WTC Community-Labor Coalition's CBPR Expert Advisory Committee (hereafter, "Expert Advisory Committee") has provided an independent assessment of EPA's Draft Proposed Sampling Program. The WTC Community-Labor Coalition supports the findings of the Expert Advisory Committee. The findings of the Expert Advisory Committee are included in their entirety in Section 3 of this document, are referenced throughout this document, and additionally, have been submitted to EPA under separate cover.

We urge all members of the EPA Expert Technical Review Panel to give serious consideration to the findings of the Expert Advisory Committee.

We call upon the EPA to reformulate the Draft Proposed Sampling Program based upon the findings of the Expert Advisory Committee and the WTC Community-Labor Coalition's comments.

To this end, we submit the following comments on EPA's Draft Proposed Sampling Program in our own names, and in the names of the thousands of workers and residents whom we represent.

The summary of the WTC Community-Labor Coalition's recommendations is as follows:

- **The EPA must sample for and clean up toxic indoor WTC contamination as quickly as practicable.** The Draft Proposed Sampling Program does not contain a clear commitment to clean up contaminants when found and the decision-making criteria for cleanup are vague. The Expert Advisory Committee states that the primary objective of the Draft Proposed Sampling Program "must be to identify habitable spaces with ongoing World Trade Center (WTC) contamination and provide cleanup where warranted." The Expert Advisory Committee further recommends, "There is an urgent need to quickly identify indoor spaces where WTC toxics pose a threat to human health and to clean these spaces immediately.";

- **The EPA must not wait for discovery and validation of a "WTC chemical signature" (which may never be identified) before beginning a sampling and cleanup program.** The sampling and cleanup program must proceed independently of the signature research, which will likely take years to complete and ultimately, may not be successful. In contrast, the Draft Proposed Sampling Program is contingent upon the discovery of a WTC signature. The Expert Advisory Committee states, "Whether or not a signature is found, it is essential to clean up any contamination resulting from the WTC event.";

- **Affected neighborhoods in Brooklyn and other areas likely to have been impacted by the disaster must be included in the initial sampling and cleanup program.** The EPA's proposed geographic zone for initial sampling fails to include these areas, relegating them to a "Phase II" which may never materialize. The Expert Advisory Committee states, "The proposal does not describe the rationale for excluding Brooklyn or limiting the study area to lower Manhattan. Sampling of buildings should be much broader than planned and should be based on the extent of the plume as determined either by the NASA photos or other appropriate methods." The Expert Advisory Committee further recommends, "Consideration must also be given to areas from which residents have been reported to exhibit adverse respiratory health effects…";

- **The results of all samples taken of toxic substances must be included in the cleanup decision-making criteria.** The Draft Proposed Sampling Program wrongly discounts contamination of infrequently cleaned or low contact and "inaccessible" indoor areas. The Expert Advisory Committee states, "The dust samples present in inaccessible locations, like those found in HVAC ducts or ceiling plenums, represent the most significant reservoirs of contaminated dusts available for introduction into residential living space and work space alike. These reservoirs must receive the highest priority in the sampling program design.";

- **Small asbestos fibers (i.e., less than 5 microns in length) must be included in the sampling results and considered in assessments as to whether or not cleaning is warranted.** The proposed sampling methods are inadequate for identifying very small fibers and particles that may pose significant health threats. The Expert

Advisory Committee states, "Short fibers should be sampled and reported. Any assumption that short fibers, less than 5 microns in length, are not hazardous cannot be justified based on the available science.";

- **The list of proposed contaminants for sampling (asbestos, man-made vitreous fibers, crystalline silica, polycyclic aromatic hydrocarbons, and lead) must be expanded to include particulate mercury and dioxin.** The Expert Advisory Committee noted that many of the sampling and analytical methods used by the EPA to restrict the contaminants of potential concern (COPCs) to be tested were "inadequate" and resulted "in the elimination of many substances found frequently at hazardous levels in many buildings";

- **The process for selection of buildings to be tested must be elucidated and should incorporate additional factors that can, according to the Expert Advisory Committee, "affect a building unit's accumulation and retention of WTC toxics."** Information must also be collected for buildings that are not included in the sampling program to assess whether or not the buildings sampled are truly representative, and if not, to determine how the results may be biased. The Expert Advisory Committee states, "The proposal for selection of buildings is vague and appears to be flawed.";

- **A detailed rationale must be provided for the "triggers" for cleanup, (i.e., benchmarks used to determine whether cleanup is conducted).** The EPA plan proposes an arbitrary "trigger" of "3X background" for certain contaminants without describing how the background levels will be determined and without providing a rationale as to why the "3X background level" was chosen for each of the contaminants tested. The EPA plan fails to consider the potential health consequences of chemical mixtures. The Expert Advisory Committee states, "As a result of the failure to consider mixtures, specific health effects are likely to be underestimated by the benchmark of one set of contaminants.";

- **The Draft Proposed Sampling Plan must contain a quality assurance/quality control (QA/QC) protocol to make sure that testing and analysis will be carried out properly.** The Draft Proposed Sampling Program barely addresses the issue of quality assurance/quality control. The Expert Advisory Committee states, "The proposed sampling program must represent a state-of-the-art sampling and analysis effort with adequate QA/QC employed such that the data are fully defensible."

The ultimate success of this endeavor will depend upon public confidence that the sampling program is designed to find – rather than avoid finding – any remaining toxic indoor hazards from 9/11. A necessary component of any large-scale sampling program, and one which is omitted from EPA's proposal, is an aggressive, well-developed and well-funded outreach program, designed with close involvement of the affected communities and incorporating appropriate incentives to encourage participation. This can best be achieved by a clear and unequivocal public commitment from the federal government to conduct cleanup of hazardous WTC contaminants when they are discovered.

SECTION II: RECOMMENDATIONS, COMMENTS, QUESTIONS

Objectives of the Sampling Plan

It is our position that the goal of this sampling program should be to find whatever World Trade Center pollution is out there in the home or workplace environment that may still present a risk to human health, and to remove it.

The Expert Advisory Committee has come to a similar conclusion, stating, “It is imperative that indoor spaces be cleaned of WTC toxics whether or not a signature is found. Since the studies needed to determine whether or not a signature exists are likely to take years, the cleanup process must not be held hostage to the development of a signature. The stated objectives need to be restated with this recognized. In addition, to assure participation, cleanup and health liabilities need to be addressed.”

Proposed List of Contaminants to Be Sampled

The sampling proposal identifies five substances to be sampled – asbestos, man-made vitreous fibers (MMVF), crystalline silica, polycyclic aromatic hydrocarbons (PAHs), and lead. The EPA proposal does not call for testing of short, very thin chrysotile asbestos fibers, or for the testing of mercury, nor does it address the potential presence of toxic halogenated organic chemicals, such as dioxins.

The WTC Community calls on EPA to expand its list to include, at a minimum, particulate mercury and dioxin, and also to count and report short asbestos fibers.

The Expert Advisory Committee noted that many of the sampling and analytical methods used by the EPA to restrict the COPCs to be tested were "inadequate," and resulted "in the elimination of many substances found frequently at hazardous levels in many buildings"

Non-governmental testing found mercury at levels of concern at 90 Church Street, 130 Liberty Street, 4 Albany Street, and 30 West Broadway. The Expert Advisory Committee observes that EPA may have missed the presence of mercury in its testing because it tested for mercury in vapor form, not particulate form, which is the more likely form in which mercury would persist in the indoor environment.

The Expert Advisory Committee notes that dioxin has been found at levels above health-based benchmarks in some commercial and government buildings. In fact, with regard to dioxin, EPA itself has stated "It would be reasonable to conclude that the concentrations to which individuals could be potentially exposed ... within and near the WTC site through the latter part of November are likely the highest ambient concentrations that have ever been reported." (Exposure And Human Health Evaluation Of Airborne Pollution From The World Trade Center Disaster, Oct. 2002) While acknowledging the cost of dioxin testing, the Expert Advisory Committee nevertheless urges that sampling be conducted for dioxins, and suggests that EPA consider using the CALUX assay for dioxin-like activity.

The Expert Advisory Committee states that "any assumption that short (asbestos) fibers, less than 5 ų [microns] in length, are not hazardous cannot be justified based on the available science." The WTC Community agrees with the Expert Advisory Committee's recommendation that any sampling plan report and take into account sampling results for short asbestos fibers. The Expert Advisory Committee provides numerous citations in the scientific literature to support its concern about the toxicity of such short fibers. It further observes that fiber alteration may be a variable in ability to cause disease, and that fibers may have been altered as a result of the WTC event.

Proposed Geographic Scope of Sampling

Affected neighborhoods in Brooklyn and other areas likely to have been impacted by the disaster should be included in the initial sampling and cleanup program, not relegated to a "Phase II" which may never materialize.

The Expert Advisory Committee states, "The proposal does not describe the rationale for excluding Brooklyn or limiting the study area to lower Manhattan. Sampling of buildings should be much broader than planned and should be based on the extent of the plume as determined either by the NASA photos or other appropriate methods." Their report notes that the contaminants that traveled across the river are likely to include more of the smaller, combustion-related particles and observes that, "there may have been less of the larger, heavier particles depositing in Brooklyn than Manhattan, but the smaller fibers are readily suspended and can travel to Brooklyn. Given the frequent wind direction to the east and southeast, Brooklyn should be tested in Phase 1."

The Expert Advisory Committee is in agreement with the Community's position as stated in the "Seven Principles" adopted by more than 50 community and labor organizations and all 3 Lower Manhattan community boards (included as Appendix II of this report).

The Expert Advisory Committee recommends further that the sampling plan consider "areas from which residents have been reported to exhibit adverse respiratory health effects." EPA should, in particular, consider the medical evidence provided by the Stonybrook University study of asthma impacts from WTC pollution in determining the geographic scope of sampling.[1] The scientists who conducted that study determined that asthmatic children who lived within 5 miles of Ground Zero suffered a deterioration in their health and had to visit their doctors more often for treatment and take more medicine for asthma during the year after the 9/11 attack than the children at a comparison clinic in Queens. The Expert Advisory Committee's recommendation against delay in testing, that no area at risk should be relegated to a so-called "Phase II" for initial testing, applies to such neighborhoods as well.

[1] Anthony Szema, *et al*., "Clinical Deterioration in Pediatric Asthmatic Patients After September 11, 2001," *J. Allergy Clin. Immunol.* 113(3):420-426 (2004).

Proposed "Trigger Factors" to Determine the Need for Cleanup

EPA's proposed decision-making criteria to determine whether or not cleanup is needed fails to protect public health because it: (1) inappropriately discounts the presence and availability of contamination in low contact and/or less frequently cleaned and/or inaccessible areas; (2) proposes vague, arbitrary, and unsubstantiated guidelines for the contamination level(s) that would trigger a cleanup; and (3) relies on inappropriate averaging of test results that would significantly underestimate levels of contamination.

Less frequently cleaned and inaccessible areas: We oppose EPA's plan to disregard test results from "inaccessible" areas in the decision-making for cleanup. The two examples that EPA cites as "inaccessible" areas are "behind or on top of cabinets." In reality, such locations are not inaccessible, but rather low contact or less frequently cleaned locations. Contamination that may accumulate in these areas can be disturbed by activities such as cleaning, moving furniture, removing items from tops of cabinets, and/or remodeling/renovations.

The Expert Advisory Committee further warns that exposures from inaccessible areas – such as HVAC systems and ceiling plenums – can occur without direct human contact with the area itself. The Expert Advisory Committee states "it is not appropriate to fail to utilize contaminant levels from inaccessible areas as a consideration for cleanup," such as HVAC systems or ceiling plenums, because they represent "reservoirs" that could cause the release of pollutants to recontaminate an indoor area.

The Executive Summary of the Expert Advisory Committee report states, "Inaccessible areas are restrictive to human activity, not to airborne toxics that circulate in all air spaces to some degree. These represent reservoirs of contamination or "hot spots" and should be prioritized for examination and cleanup if warranted. There is an urgent need to quickly identify indoor spaces where WTC toxics pose a threat to human health and to clean these spaces immediately."

We concur with the Expert Advisory Committee that "none of the sampling should be excluded from cleanup decision-making criteria" and that "cleaning should target the reservoirs of the toxics."

Arbitrary guideline for clean-up: In the absence of available health-based benchmarks for dust samples of asbestos, MMVF, and crystalline silica, the current sampling plan proposes a 3X background level as the trigger for cleanup. However, the EPA does not define background or how background will be determined, nor is a plausible rationale provided for using the 3X background benchmark. The Expert Advisory Committee states that "further justification of the 3X background criteria is needed" We agree with the Expert Advisory Committee that there must be "reasonable assurances that 3X background is safe." It is also inappropriate to use a 'one size fits all' approach for all of the contaminants. The Expert Advisory Committee notes, for example, that asbestos would be of much greater concern at three times background than man-made vitreous fibers.

Further, valid comparison of background and sampled levels for any given substance requires that collection and analysis methods be identical. The sampling proposal gives no consideration to this basic concept.

The 3X background trigger also fails to take into consideration the potential health effects of contaminant mixtures. The Expert Advisory Committee notes that, "No consideration has been given in the sampling plan to the cumulative effects of the COPCs or signature compounds when individual contaminants are found below published health effects thresholds. More importantly, no consideration has been given to the complex chemical universe present on these dusts. Many of these compounds are not regulated in any fashion and the vast majority have not been adequately assessed for health effects."

Inappropriate averaging of test results: EPA proposes using a 95% upper confidence limit standard on the mean contaminant level in a building to determine whether the building should be cleaned. The Expert Advisory Committee warns that the 95% upper confidence limit is "not a defensible criterion" in this context due to variability in contamination as well as to building characteristics such as size, etc. Under the EPA proposal, the potential impact of any reservoirs of contamination will be misleadingly underestimated by averaging test results of these areas with results from frequently cleaned areas. The Expert Advisory Committee states, "Hard accessible surfaces should not be included in the overall mean."

We agree with the Expert Advisory Committee statement that, "As a general principle, if dusts collected in an individual residence/apartment or workplace are found to contain COPC/target parameters above threshold levels, that residence or workplace should be cleaned. This should be the practice despite the outcome of statistical analyses done on all samples collected in that building. These locations should be considered 'hot spots'. All hot spots should be remediated."

Proposed Method to Determine Cleanup Responsibility (The "WTC Signature" Issue)

The proposed sampling plan states that "the existence of a reliable signature for WTC dust and/or combustion products" is a "cornerstone of this proposal" (Sampling Proposal, p. 2). However, the proposal's virtually exclusive reliance on possible identification of one or more signatures raises 2 types of issues – scientific validity and ramifications for the sampling process.

As a scientific matter, discovering and validating an actual WTC signature is difficult, or even improbable, for a number of reasons. The current proposal states that the signature study must be "fully successful in identifying a signature in indoor dust that can be reliably tied to the building collapse," yet states no objective criteria by which to assess the validity of a signature.

In the search for a signature, the proposal assumes that dispersion of contamination from the events of 9/11 and thereafter derived solely from 2 events – the collapse of the towers and 4 months of ensuing combustion. However, primary dust contamination resulted from the collapse and secondary contamination from the transport of debris by truck through the streets to the waste transfer stations. Further, dust originating in all collapsed buildings should not be presumed to be identical, due to differing structural components, furnishings, and materials and substances present (e.g., freon, diesel fuel, electrical transformers, jet fuel, battery acid, etc.). The Expert Advisory Committee points out that there were three types of fires – the fire before the collapse, high- temperature fires, and low- temperature smoldering fires. The products of these fires would be different as well.

The amorphous, heterogeneous nature of the WTC dust, both in the original polluting event and through the course of possible re-suspension over time increases the difficulty of signature validation. The current sampling plan does not consider that the content of WTC dust varied based on deposition distance, since different substances and differently sized particles have varying abilities to be transported over distance. For instance, a signature derived solely from samples taken close to the WTC site is likely to be inappropriate for assessing Brooklyn sites. The Expert Advisory Committee emphasizes that the deposition patterns of the different materials varied. It states, "WTC dust and combustion products will become fractionalized by distance, orientation, elevation, building characteristics, interior surfaces and cleaning history."

The current proposal does not adequately acknowledge that the sampling program occurs more than three years after the event. (This delay is not the fault of the community. We have been requesting proper testing throughout this entire period.) The Expert Advisory Committee points out that the passage of time "means that there will be an overlay of new substances that can obscure a WTC pattern." We must assume that some mixing of dust will occur in some, if not many, instances. If developed at all, any signature must be defined with ample flexibility to consider the likely mixing of ordinary dust with WTC dust. Indeed, the Expert Advisory Committee, taking account of all these complexities, observed that "multiple signatures may need to be developed to account for location-specific factors."

Whether or not one or more signatures does in fact exist and will be validated is unknown at this time. The length of time that may be necessary to identify and validate a signature, or to fail to

do so, is likewise unknown. In addition, signature validation should be subject to independent peer review, adding further delay to the process of sampling and possible cleanup.

The Expert Advisory Committee states, "Awaiting availability of valid WTC chemical signatures, applicable to building collapse and emissions form the ensuing fires, respectively, will likely delay cleanup, if cleanup takes place at all. It is essential that cleanup of WTC toxics occurs as soon as practical even in the absence of a valid signature."

The current sampling proposal is almost entirely dependent upon one or more signatures, yet to be confirmed. There is no "Plan B," that is, the proposal does not posit a way to move forward with sampling and cleanup if a signature cannot be validated and does not take into account that delays in signature validation effectively will result in delays in sampling. A consequence of reliance on yet to be determined signatures for cleanup decisions is that commitment to cleanup cannot be made, with probable negative ramifications for voluntary enrollment in the sampling program.

It continues to be the WTC Community's position that the EPA must not wait for discovery and validation of a "WTC chemical signature" (which may never be identified) before beginning a sampling and cleanup program. That program must proceed independently of the signature research, which, in the opinion of the Expert Advisory Committee, may take a lengthy period of time to complete and ultimately may not be successful.

It may be more realistic to expect that WTC dust can only be identified on a "more likely than not" basis, as indicated by the presence of one or more substances from a list of likely contaminants. Decisions about further testing in a neighborhood or beyond the Phase I test zone could be based reasonably on evidence that falls short of a definitive "WTC chemical signature." The Expert Advisory Panel affirms that cleanup is the priority, not the "signature": "Whether or not a signature is found, it is essential to clean up any contamination resulting from the WTC event."

While the discussion of the so-called "signature" for identifying WTC dust has been posed as a scientific issue, EPA has directly linked it to the policy issue of who cleans up contamination when it is found. Under the current proposal, if testing a space reveals exceedences of contaminants known to be components of WTC dust--even those identified as COPCs in EPA's own 2003 guidance document, "World Trade Center Indoor Air Assessment--but the precise WTC signature is not found, EPA refuses to provide a cleanup. As a pragmatic matter, EPA must not be allowed to overly limit any such signature. Any signature, if used at all, should not be so rigidly defined as to exclude genuine cases of WTC contamination and unfairly burden individual owners with a cleanup problem that rightly should be remedied by the federal government.

Too, inappropriately limiting EPA cleanup would tend to discourage participation in the program by people who, in the event that the so-called WTC signature is not found, could not afford to clean up the dust in a coop apartment or home that they own, or in their small business. This policy would also present a problem for tenants who cannot afford to battle with their landlords over cleanup and would have little or no practical remedy if contaminants are discovered

The Expert Advisory Committee argues that a viable plan can be developed in the absence of a validated signature, noting that many buildings in the WTC vicinity have already been sampled, cleaned and remediated without it. Our Advisory Committee proposes that if the contaminants of potential concern exceed health criteria or another acceptable benchmark, "then that space should be identified for cleanup." It argues that if a chemical such as lead can be demonstrated to have come from a non-WTC source, then government agencies should cooperate to identify the responsible party.

The standard for cleanup of contaminated dust should not – and cannot – be absolute "certainty" of WTC origin. It would be more appropriate to structure the program so that where exceedences of the tested Contaminants of Potential Concern occur, EPA conducts cleanup unless EPA demonstrates clearly that another source resulted in the contamination and another identifiable party is responsible for cleaning it up.

The program will need to be designed to attract participation by residential and commercial tenants, owner-occupied residences and large building owners. Getting a home or building tested involves inconvenience and sometimes disturbance of personal belongings. For owner-occupied residences where the owner has volunteered to participate, special care must be taken to ensure that there is no disincentive to participate. The Expert Advisory Committee observes, "If unit cleanup costs are relatively inexpensive compared to the costs of conducting the research, some researchers consider it an ethical obligation to pay for the cleanup of contaminated units at the end of the study," which, the Expert Advisory Committee notes, provides an incentive for participation and thus improves the overall study design.

As noted above, any "signature," if developed at all, must be defined with ample flexibility to consider the likely mixing of ordinary dust with WTC dust, the heterogeneous nature of the dust itself, and the uneven deposition of the dust in the environment. The standard should not – and probably cannot – be absolute "certainty." The cleanup trigger must be designed to protect the public from further exposure to WTC dust. That must be the primary goal – not absolute certainty of source more than three years after an event.

Proposed "Trigger Factors" For Expanded Testing

If the presence of contaminants has been detected in samples taken from a given building under this program, three important decisions must be made:

- whether or not further testing should be done of that building;
- whether or not further testing should be done in buildings in the surrounding area and
- if the site is located near the border of the Phase I testing zone, whether or not testing should be expanded beyond that border.

The EPA proposal does not provide satisfactory answers to these questions.

The answer is relatively straightforward with regard to individual buildings. The Expert Advisory Committee recommends that if units within a building tend to have similar levels of contaminants, then the entire building should be cleaned. It notes, in addition, that in some instances it may be more practical to clean an entire building ventilation system regardless of variation in contamination of units in the building.

The questions of expanded neighborhood testing and expansion of testing zones are more challenging -- and yet critical to answer. The goal of this project, after all, should be to identify and clean up all contaminated indoor spaces that threaten human health. Because the sampling plan is not designed to promote collection of samples from multiple buildings in the same neighborhood, the Expert Advisory Committee suggests conducting multiple building sampling in some neighborhoods and plume corridors as a means to assess whether data from one building predict those in neighboring buildings, and as a step toward evaluating what factors predict area-wide contamination. It notes that EPA probably will need to evaluate a variety of geographic and non-geographic factors to determine what best predicts contamination of untested buildings.

We strongly urge that EPA provide a clear plan for identifying the "next step" expanded cleaning needs.

Proposed Sampling Design

Sampling plan design as currently proposed is seriously flawed in several regards. It is almost entirely reliant on self-enrollment of participants. As a result, due to potential liability concerns, the proposed sampling design creates a disincentive to enrollment by landlords or employers who did not engage in post 9/11 cleanup. Consequently, indoor spaces that have been remediated are likely to be over-represented in sampling results, while spaces that have not been cleaned up are likely to be under-represented. The Expert Advisory Committee notes, "Self-selection prior to sampling will bias the results significantly by underestimating the degree of contamination. Volunteers are more likely to be aware of the WTC risks, and are more likely to have taken preventative and remedial action (e.g., professional cleaning and remediation). Building owners and employers who fear health and cleanup liability are less likely to volunteer."

Perhaps the most serious disincentive to enrollment in the sampling plan as currently proposed is the omission of a clear and unambiguous government commitment to cleanup where warranted. Given the history of the past 3 years and the levels of mistrust that have ensued, it is likely that many downtown property owners, employers, and residents will be reluctant to participate in a government program that contains no clear promise to address contaminants, if found. The Expert Advisory Committee notes that, "Government-funded cleanup of toxics is essential for gaining participation", and recommends making a structured random sample of buildings, and then approaching the selecting building owners and tenants. The Committee further suggests that building variables (such as building type, location, type of ventilation system, and cleaning history) be compared for volunteered and non-volunteered buildings in order to determine whether or not volunteered buildings are likely to be representative of all eligible buildings .

Since the proposed sampling plan contains no provision for assessing prior sampling results or cleanup histories of buildings that do not self-enroll, the actual extent of sampling bias will not be known. In addition, although the plan allows for individual residential tenants to self-enroll, access to common spaces and to mechanical ventilation systems is to be controlled by the landlord, and access to workplaces is to be controlled by the employer. This arrangement effectively disenfranchises the overwhelming majority of downtown residents and workers by preventing them from requesting sampling, and possibly cleanup, of their indoor spaces.

The sampling proposal relies on a two-dimensional grid process to ensure that selected buildings are geographically representative. The current proposal, however, is not designed to factor in non-spatial criteria which may ultimately influence the how representative the sample will be. According to the Expert Advisory Committee, "buildings, and units within buildings, are expected to vary in their accumulation and retention of WTC toxics depending upon many factors: distance, altitude, cardinal orientation, penetration rates (i.e., how easy it is for outside toxics to penetrate a building through closed windows, ventilation intakes, tracking in, etc.), window usage, type of ventilation system, and cleaning history." 3,3 Three-dimensional factors such as height above the ground of ventilation intakes cannot be factored in to the proposal's 2-dimensional model.

Building selection must also take into account the dispersion and deposition processes of the various types, and sources, of contaminants. But according to the Expert Advisory Committee,

“A sufficient sample size will be necessary to be able to characterize the range of penetration possibilities within and between buildings. The proposal is not sufficiently detailed to demonstrate that this will be accomplished.”

Sample Collection and Analysis

Given the high proportion of very small particles and fibers deposited inside homes and work spaces by the World Trade Center Collapse and subsequent fires, we believe it is imperative that sampling and analysis methods utilized be capable of capture and detection of very small particles. The HEPA vacuum method proposed in the sampling plan will not capture these very small asbestos and man made vitreous fibers. Consequently, the Expert Advisory Committee recommends that wipe sampling, as well as HEPA sampling, be used to test hard surfaces for those analytes: "Smoke residues and, in particular, contaminants associated with smaller yet inhalable particles, will not be sufficiently removed by the proposed HEPA collection technique. The wipe sample will ensure these contaminants are included in the total concentrations of target compounds/COPC present on the sampling surface."

We are very concerned that sampling proposal is seriously deficient in its failure to address sampling for lead and PAHs on soft surfaces such as carpets and upholstered furniture. According to the Expert Advisory Committee, "Soft surfaces such as fabrics are ideal deposition surfaces for particulates and serve as reservoirs for the contaminants", and recommends: "Particle associated lead and PAHs present in soft surfaces should then be sampled in an identical fashion to what is proposed for asbestos, silica, and MMVF."

Within HVAC systems, particulate deposition is most likely to occur in low velocity areas in duct work and at bends in high velocity areas. Although the proposed sampling plan calls for monitoring at various locations within HVAC systems, it does not address "dead spots" which are the areas most likely to have become reservoirs for WTC contaminants and potential sources for their resuspension and entrainment. The Expert Advisory Committee recommends that the sampling plan be revised to more specifically designate what parts of the HVAC system should be sampled and the minimum number of samples per square foot to be collected

Analytical methods for asbestos, MMVF, and silica are not provided in EPA's draft sampling proposal. The proposal is not complete without this information and therefore cannot be adequately evaluated in this regard.

Need for Quality Assurance and Quality Control and Disclosure of Test Results

EPA's current Draft Proposed Sampling Plan addresses the need for quality assurance and quality control (QA/QC) only in passing. The Expert Advisory Panel has stated that the proposal should contain a fully developed quality assurance/quality control (QA/QC) protocol to ensure that testing and analysis is carried out properly.

First, such a protocol must include a system for independent monitoring (including actual "spot checking") of sampling and analysis. EPA and the WTC Expert Technical Review Panel have heard extensive testimony on numerous testing and cleanup protocol violations and other improper work practices that occurred during the 2002 EPA Residential Cleanup Program, supervised – or perhaps unsupervised – by EPA. For example, the testers did not run a fan during air testing, and the cleaners did not cover the intake/discharge registers with plastic. Cleanup workers were also observed working without personal protective equipment. Additional flaws and failures in EPA's 2002 indoor cleanup program are documented in the Sierra Club's 2004 report, *Pollution and Deception at Ground Zero.*

Second, disclosure of sampling results and monitoring data in a timely fashion to building owners and to all building occupants – including workers – is critical. In testimony at Panel meetings about this issue, affected tenants or building occupants have voiced concern because of the difficulties in obtaining the results of EPA sampling in a timely way.

Finally, quality assurance and quality control will be key to building public confidence in a future WTC contamination cleanup project.

The Expert Advisory Committee states, "The proposed sampling program must represent a state-of-the-art sampling and analysis effort with adequate QA/QC employed such that the data are fully defensible."

Conclusion

The Expert Advisory Committee rightly observes that this "proposed program is not simply a sampling program," and that the title should "include a statement concerning adequacy of the cleanup for the safety of the occupants." This, ultimately, is the goal of our endeavors. We urge EPA to adopt the recommendations set out in these comments and in the Expert Advisory Committee's review of the sampling program, and we urge the WTC Expert Technical Review Panel to join in this effort to obtain a truly effective, scientifically valid, credible program for sampling and cleanup of WTC pollution.

Appendix I: Community Requests of EPA that Remain Unmet

We urge EPA to respond to these five unmet requests regarding information and procedure to our CBPR process:

1. **Declare a solid commitment to conduct prompt cleanup.** Members of the community have emphasized that the sampling plan will fail – because people will not volunteer their homes or offices for testing – unless EPA makes a strong commitment to conduct cleanup of any hazards likely to have come from WTC pollution.

2. **Assert regulatory authority over the imminent or ongoing demolition of the buildings highly contaminated by WTC dust.** The highly contaminated high-rise buildings such as the 40-story former Deutsche Bank Building (130 Liberty Street) and Fiterman Hall (30 West Broadway) are slated for demolition, while 4 Albany Street currently is already underway. Other contaminated buildings such as 130 Cedar Street may be demolished or undergo substantial renovation soon as well. We have urged that EPA supervise safety during the demolition of such buildings.

3. **Provide a legal memorandum describing the powers of various agencies to gain access to buildings for environmental testing and how those powers might be combined to help effectuate this sampling and cleanup project.** While a resident can request testing of his or her own apartment, one cannot have testing of a building's common areas or ventilation system where the owner opposes it without power of access. Similarly, employees cannot obtain testing of their workplace, where an employer and building owner oppose it, unless an agency can override such opposition. Although this issue has been repeatedly requested at Panel meetings, to date no such legal memorandum has surfaced.

4. **Establish a systematic effort to collect and to establish a central database of all 9/11-related indoor environmental sampling data results from public and private sources.** This should include government agencies, academic centers and independent sources. Although there have been repeated requests, there appears to have been no movement on this issue.

5. **Produce verbatim transcripts of EPA Panel meetings.** This is important both as a matter of public record and to ensure the integrity of the panel process. Community members have pointed out anomalies and errors in EPA summaries of the meetings in the past.

Appendix II: 7 Principles Letter

October 26, 2004 (signatories updated 12/17/04)

Michael O. Leavitt
Administrator
U.S. Environmental Protection Agency
Ariel Rios Bldg.
1200 Pennsylvania Ave NW
Washington, DC 20460

Dear Administrator Leavitt:

We are community, tenant, religious, disaster recovery, social service, environmental and labor organizations, and residents, workers, and small business owners in the affected areas, who have been concerned by unaddressed environmental and public health issues since Sept. 11, 2001. Many of us have diligently participated in the EPA World Trade Center Expert Technical Review Panel process that began in March 2004, and our work as community representatives in that process was recently placed on a formal basis by EPA.

In our own names, and in the names of the thousands of workers and residents whom we represent, we make the following statement and request:

The lower Manhattan and Brooklyn communities, both residents and workers, have, for three years, called on EPA to clean up the contaminants left behind by the terrorist attacks of September 11, 2001. For three years, EPA has been unresponsive to the appeals of our communities, our elected representatives, and EPA's own Inspector General. For the last eight months, lower Manhattan and Brooklyn residents and workers have worked, in good faith, as closely with the EPA WTC Technical Expert Review Panel as we have been permitted to do. We appreciate the efforts of panel members and we hope to be able to continue working with the panel.

Nevertheless, eight months after this panel began its work, no additional environmental testing or clean-up has been conducted. Our children, our neighbors, our co-workers, and our firefighters continue to live with the uncertainty of possible exposure and unnecessary risk. After three years of delay by EPA and eight months of work by this panel, EPA has yet to make a public commitment to testing and decontamination.

We therefore call upon EPA, by the end of October 2004, to publicly commit itself in a written statement released at a press conference presided over by an official EPA spokesperson to the following seven principles:

1. EPA will conduct, with appropriate input from the community, comprehensive indoor environmental testing for multiple contaminants. The testing will occur as promptly as possible.

2. EPA will expand the geographic range of the testing from its original boundaries to include, at a minimum, additional southern Manhattan communities, including all of Chinatown, the Lower East Side, and also the neighborhoods in Brooklyn affected by World Trade Center dust.

3. EPA will test both residences and workplaces. Landlords, residents, employers, and employees will all be given the option of volunteering to have their respective buildings, residences, and workplaces tested.

4. EPA testing will include mechanical ventilation systems.

5. Where test results warrant, EPA will decontaminate not only the tested buildings but the neighborhoods affected by 9/11 contaminants. The clean-up clearance criterion for each identified contaminant will be based upon consideration of health-based benchmarks and background levels, utilizing the criterion that is more protective.

6. EPA will, with appropriate community input, take the lead role in supervising the environmental safety of all 9/11-related clean-up, demolition, and reconstruction activities.

7. As EPA evaluates unmet health needs resulting from the attacks, it will support all necessary national and local efforts to ensure public health education, outreach, and long-term medical follow-up for affected communities and to ensure medical care for affected individuals.

This statement of principles is endorsed by the following community, residential, tenant, religious, disaster recovery, social service, environmental, small business and labor organizations and businesses:

Manhattan Community Board No. 1 (by resolution)
Manhattan Community Board No. 2 (by resolution)
Manhattan Community Board No. 3 (by resolution)
9/11 Environmental Action (residents and school parents organization)
Asian American Legal Defense and Education Fund (AALDEF)
Association of Legal Aid Attorneys, UAW 2325, AFL-CIO
Battery Park City United
Candy World (small business)
Chinese Progressive Association
Citizens Environmental Coalition (CEC)
Civil Service Employees Association (CSEA)
Communications Workers of America (CWA), District 1

Communications Workers of America (CWA), Local 1180
District Council 37, AFSCME
Duane Street Block Association
Essex World Cafe (small business)
Family Association of Tribeca East (FATE)
Fiscal Policy Institute
Good Jobs New York
Good Old Lower East Side (GOLES)
Greater NY Labor and Religion Coalition
Independence Plaza North Tenants Association (IPNTA)
Investor Data Services (small business)
Little Italy Neighbors Association (LINA)
Manhattan Trustee Rudy Sanfilippo, Uniformed Firefighters Association
Met Council on Housing
National Postal Mail Handlers Union, Local 300
National Treasury Employees Union, Chapter 293
New Jersey Work Environment Council
New York City Coalition to End Lead Poisoning (NYCCELP)
New York Committee for Occupational Safety and Health (NYCOSH)
New York Disaster Interfaith Services (NYDIS)
New York Environmental Law & Justice Project (NYELJP)
New York From the Ground Up (represents 600 small businesses in the WTC area)
New York State Public Employees Federation (PEF)
Organization of Staff Analysts (OSA)
Parents Association of Stuyvesant High School
Physicians for Social Responsibility - New York City
Pop Filter Music (small business)
Professional Staff Congress (PSC)
Puerto Rican Legal Defense and Education Fund (PRLDEF)
Rebuild with a Spotlight on the Poor Coalition (represents 20 community-based organizations)
Residents of 125 Cedar Street
Sierra Club
Sierra Club - Fairfield County Group (Connecticut)
Tenants and Neighbors
The 2M Corporation (small business)
Transport Workers Union (TWU), Local 100
Uniformed EMTs & Paramedics - FDNY (EMTs & paramedics from Fire Dept)
Uniformed Fire Officers Association
United Federation of Teachers
University Settlement
Worthy Eyes (small business)
WTC Residents Coalition (represents 30,000 Battery Park City residents)

SECTION III

Expert Advisory Committee

Synthesis Report

CBPR EXPERT ADVISORY COMMITTEE
REVIEW OF THE DOCUMENT ENTITLED,

"Draft Proposed Sampling Program to Determine Extent of World Trade Center Impacts to the Indoor Environment"

David O. Carpenter, M.D., University at Albany, Chair
Scott M. Bartell, Ph.D., Emory University
Paul W. Bartlett, B.E.S., M.A., City University of New York (on leave)
John Dement, Ph.D, CIH, Duke University
Liam O. Horgan, CIH, Assessment Resources & Technologies, Inc.
Gary T. Hunt, M.S., QEP, TRC Companies, Inc.
Richard A. Lemen, Ph.D., Ass't Surgeon General, US Public Health Service (retired)

EXECUTIVE SUMMARY

Implementation of the sampling plan as written will be problematic. The Phase I and Phase II sampling presupposes the identification of a WTC chemical "signature". Development and validation of this signature is a work in progress at present. Awaiting availability of a valid WTC chemical signature applicable to both building collapse and emissions from the ensuing fires, respectively, will likely delay cleanup, if cleanup takes place at all. It is essential that cleanup of WTC toxics occurs as soon as practical even in the absence of a valid signature.

The sampling proposed is not extensive enough to cover all areas likely affected by the building collapse and approximately 100 day period of fires that ensued. Furthermore the sampling should extend beyond the affected areas in order to obtain information on background levels utilizing identical types of sampling locations within buildings, sample collection methods, analytical procedures and quality assurance/quality control (QA/QC) methods. The plan for selecting buildings and building units for contaminants sampling is not described in sufficient detail. The proposal to sample only buildings that volunteer to participate will likely seriously bias the results toward not finding representative levels of contamination.

The sampling procedures are not adequate to collect small fibers and particles, which may pose significant health threats and be more concentrated in the indoor environment. There is no developed QA/QC protocol in the plan. Given the period of time that has passed since 9/11, it is not appropriate to fail to utilize contaminant levels from inaccessible areas as a consideration for cleanup. Inaccessible areas are restrictive to human activity, not to airborne toxics that circulate in all air spaces to some degree. These represent reservoirs of contamination or "hot spots" and should be prioritized for examination and cleanup if warranted. There is an urgent need to quickly

identify indoor spaces where WTC toxics pose a threat to human health and to clean these spaces immediately.

PROPOSED OBJECTIVES AND TITLE

1. Are the stated objectives of the Sampling Program [1] appropriate and complete? Should the stated objectives include cleanup of WTC contaminants, where found?

The stated objectives of the proposal are incomplete. The primary objective of the Sampling Program should be to identify habitable spaces with ongoing World Trade Center (WTC) contamination and provide cleanup where warranted. The intent of the two parallel programs being described (geographic extent and signature study) may be to provide data needed to determine the need for cleanup, but the statement of the objectives omits mention of cleanup and cleanup benchmarks. The first objective may place too much emphasis on characterization of the geographic extent of contamination, and too little emphasis on non-geographic factors such as cleaning history. It may be more sensible to structure the proposal and objectives around the identification and characterization of all factors that are predictive of contamination, rather than presupposing the dominance of geography.

It is essential that if WTC contaminants are found that they be cleaned up. However, meeting the objectives of the program as stated is contingent upon objective #3, the successful validation of a chemical signature for dusts and/or combustion products. As a result, the three stated objectives cannot be met simultaneously. Objectives # 1 (the proposed sampling program) and #2 (the Phase 2 sampling program), as stated, can only be met if #3 is accomplished first. It is not clear that such a signature exists, and indeed this committee feels it is unlikely that one (or more) will be found this long after the WTC collapse. It is imperative that indoor spaces be cleaned of WTC toxics whether or not a "signature" is found. Since the studies needed to determine whether or not a signature exists are likely to take years, the cleanup process must not be held hostage to the development of a signature. The stated objectives need to be restated with this recognized. In addition, to assure participation, cleanup and health liabilities need to be addressed.

2. Does the title, "Draft Proposed Sampling Program to Determine Extent of World Trade Center Impacts to the Indoor Environment" accurately characterize the purpose and limits of the proposed plan?

The proposed plan does not purport to attempt to determine the full extent of contamination, either in terms of geographic distribution or of different types of WTC contaminants (see answer to question 4), so in that respect the title is inaccurate. It should be revised to state the "…Local Geographic Extent of World Trade Center Impacts of Five Selected Contaminants of Potential Concern (COPC)..." The words "and Analyses" should be added to the title immediately following the word "Sampling". The proposed program is not simply a sampling program. To fulfill this revised title, there needs to be a clearer understanding of the criteria to expand the boundaries of the study and assurances that the sampling is sufficient to be truly representative. The title

should be more inclusive to include a statement concerning adequacy of the cleanup for the safety of the occupants.

PROPOSED GEOGRAPHIC SCOPE OF SAMPLING

3. Will the proposed process for selection of buildings to be sampled provide an adequately representative sample with regard to distance from Ground Zero, building type, building occupancy, building ventilation systems, and building cleaning history?

The proposal for selection of buildings is vague and appears to be flawed. The plan states that the generalized random-tessellation stratified (GRTS) spatially balanced sampling design described by Stevens and Olsen [2] is to be used, but does not commit to details of how it is to be employed, especially in regards to non-spatial factors. A spatially diverse sample is required to characterize the geographic extent of WTC contaminants. Although no experience using GRTS to characterize pollution from a point or a limited area source is reported, the technique will provide a sample that is evenly distributed across 2-dimensional map space, and should allow characterization of the average extent of contamination in regard to distance and orientation to the source. Altitude of air intake(s) may also be an important geographic factor in building contamination, but published GRTS techniques do not consider 3-dimensional space.

At any given distance, elevation and orientation to WTC toxic sources of exposure, there are a wide variety of non-geographic factors that will affect a building unit's accumulation and retention of WTC toxics. Buildings, and units within buildings, are expected to vary in their accumulation and retention of WTC toxics depending on many factors: distance, altitude, cardinal orientation, penetration rates (i.e., how easy it is for outside toxics to penetrate a building through closed windows, ventilation intakes, tracking in, etc.), window usage, type of ventilation system, and cleaning history. The building selection process should rely solely on criteria (1) and (3) stated on pages 4 and 5 of the Plan and other statistical criteria as appropriate. There should be a clear decision as to how many of which type of building will be sampled (apartments, public buildings, businesses), and a plan for the numbers of each type of building at varying distances from Ground Zero.

The proposal suggests drawing a sample from a list of volunteered buildings. Voluntary participation will likely result in non-representative sampling as stated on page 4 of the Plan, potentially biasing the study results through self-selection. Buildings would ideally be selected in a totally random fashion, without regard to whether or not they have been "volunteered". However, building access may ultimately require the consent of building owners, making it difficult to entirely avoid participation bias. The proposed study design collects no information on buildings that were not volunteered, making it impossible to determine the extent of participation bias. An alternative sampling approach is to first determine the location of each type of eligible building in the study region and select a sample of those buildings, and then contact building owners to request study participation. Variables that can be obtained without access to buildings

(e.g. building type, location, type of ventilation system, and cleaning history) can then be compared for volunteered and non-volunteered buildings in order to determine whether or not volunteered buildings are likely to be representative of all eligible buildings. This approach would also allow investigators to calculate a participation rate, and under certain assumptions to adjust for selection bias using missing data techniques such as the EM algorithm [3] or multiple imputation [4].

4. Given that EPA EPIC results identify probable deposition of WTC dust in Brooklyn and that NASA photos of the plume show it crossing Brooklyn on September 11, is the exclusion of Brooklyn from phase 1 sampling appropriate? Are there other considerations that should be a part of the sampling plan, such as obtaining background information and considering published health effect studies?

The proposal does not describe the rationale for excluding Brooklyn or limiting the study area to lower Manhattan. Sampling of buildings should be much broader than planned and should be based on the extent of the plume as determined either by the NASA photos or other appropriate methods. There does not appear to be adequate testing of Brooklyn to rule out contamination, and there should be identifying and sampling upwind locations for inclusion in establishment of background levels. On perhaps the day of the most intense emissions, September 11th, the plume can be clearly seen moving east to southeast over Brooklyn. *Newsday* reported that the National Weather Service Data indicated that the plume was over Brooklyn eighty percent of the time [5]. It is recognized that Manhattan was contaminated from the WTC to the East River. The East River provides a sink for some of the dust traveling close to the surface, but the plume from the fires easily transported to Brooklyn. So, given the distance, there may have been less of the larger heavier particles depositing in Brooklyn than Manhattan, but the smaller fibers are readily suspended and can travel to Brooklyn. Given the frequent wind direction to the east and southeast, Brooklyn should be tested in Phase 1.

We recommend extending the geographic area to be sampled in Phase I to include all impacted areas, obviating the need for a Phase II. Consideration should also be given to areas from which residents have been reported to exhibit adverse respiratory health effects, such as the Chinatown clinic study by Szema et al. [6] that found increased respiratory effects in children living within five miles of Ground Zero, and Reibman et al., [7] who investigated respiratory disease in residents within one mile of Ground Zero. The more time that passes the more difficult it will be to determine the source of contaminants, so all sampling should be done as soon as possible.

Another important consideration in defining the scope of the sampling is the necessity of obtaining background levels of the contaminants of potential concern (COPC) using precisely identical sampling and analytical procedures (methods, types of sampling locations, etc.) to those to be used in the Plan. It is not acceptable to use previously obtained background data with differing procedures, and it is not clear from the available documents that the sampling and analytical procedures used in previous

studies were identical to those to be employed here. Unless absolutely identical procedures were used in whatever previous information is proposed for determination of background levels of COPCs, the background sampling program should extend to areas within New York City known with a great deal of certainty not to have been affected by the WTC collapse and ensuing fires. For example, determination of background levels should include samples from upwind and downwind (out of the anticipated impact area) of the fall/winter seasonal prevailing winds.

PROPOSED SAMPLING DESIGN

5. Does the proposal adequately address the potential for heterogeneous dispersion of particulates and combustion byproducts? Does it adequately consider primary sources of contamination from collapse and combustion as well as secondary sources of contamination from rescue, recovery, and trucking and waste transfer operations?

The plan as stated does not adequately recognize the reality of the situation likely to exist in these buildings. More specifically, dusts found will be a heterogeneous mixture of the following types/dust sources: 1) those present historically prior to 9/11; 2) dusts from building collapse on 9/11; 3) dusts and smoke emitted from WTC property for approximately 100 days after 9/11 and; 4) dusts unrelated to 9/11 and WTC cleanup from normal activity and use such as tobacco smoke, wood smoke, construction etc. in the time period 2002-2005. The COPCs include fibers, which due to their relatively large surface area to mass ratio tend to stay suspended. The classic case (as sited in asbestos abatement classes) being an asbestos fiber, which with no other air currents present takes 88 hours to settle a distance of 12 feet. These fibers should be capable of migrating the greatest distance. Smaller and denser particles, of the same mass as asbestos, [polycyclic aromatic hydrocarbons (PAHs), lead] should migrate a much shorter distance. Therefore, there is almost certainly segregation of contaminants by distance. This suggests that potential "signature compounds" will vary by distance, elevation, degrees of particulate size and degree of resuspension. Therefore, the "signature compounds" may also change over time. Other metals, such as particulate mercury (mercury was known to be present in the millions of fluorescent lights, which were crushed), or perhaps ratios of two or more metals, may be better indicators. The sampling largely addresses dust dispersion. Secondary dispersion is not directly considered. The dispersion and deposition processes will vary by type of source (building collapse, combustion, waste transfer) and type of particulate. Particulate dispersion, degradation and deposition vary by particulate size, shape and chemical properties. Particulates from the pulverization of the building tend to be larger in size and prone to rapid gravitational settling. The largest particles tend to settle outside close to the emitting site. They can "grasshopper" further distances when re-suspended by heavy winds. Combustion byproducts have a higher distribution of finer particulates, which can be suspended in the air and travel airborne over great distances, subject to horizontal and upward vertical movement of turbulence and wind. Cahill, et al. [8] documented extraordinary concentrations of very fine toxic particulates on top (50

meters) of a building a mile away, but did not detect significant amounts of large fibers. The finer particulates are deposited chiefly by coming into contact with surfaces from air movements, wind and turbulence and not gravitational settling. Generally, hard surfaces are less subject to deposition, soft surfaces more so. Semi-volatile organic substances favor organic surfaces (organic films can form on hard surfaces, such as glass, providing a favorable surface for semi-volatile organic toxics). Porous fabric surfaces are ideal fine particulate deposition surfaces, so much so that they are used in particulate pollution control devices. Essentially, the original mixture of WTC contaminants will become fractionated with distance, elevation, orientation, building characteristics, interior unit surfaces and cleaning history. Complicating this process, the source emissions of some contaminants are more episodic than others so they may not be deposited uniformly in all directions or elevations. For example, PCBs were most likely emitted in greatest amounts when the electrical substation below WTC 7 was burning. Deposition will be greatest for those buildings and units in the path of the plume on those days. Deposition to interiors will depend upon the physical and chemical properties of the particle, building characteristics and interior surfaces. A sufficient sample size will be necessary to be able to characterize the range of penetration possibilities within and between buildings. The proposal is not sufficiently detailed to demonstrate that this will be accomplished.

In summary, one cannot expect a uniform mixture of WTC particulate fallout. This means that some COPCs may be present in some locations, and not other COPCs, yet originate from the WTC. Similarly, potential signature compounds from the pulverized buildings may not always be accompanied by potential signature compounds from the WTC fires, and *vice versa.*

6. Does the proposal adequately consider the limitations of using current sampling results to characterize the nature and extent of contamination that occurred three years earlier?

The current plan does not address the limitations of sampling done three years ago. The earlier sampling was not well coordinated to evaluate the areas now under consideration for sampling. The sampling took into account the massive debris from the plumes immediately after the attacks, but did not follow the affected areas adequately and did not utilize adequately sensitive sampling devices to determine the true extent of risk (i.e., short asbestos fibers and other fibers). Residues left from transport of waste should be studied by following their trail to the waste disposal sites and need to be assessed to determine further spread of the contamination to areas not thought to be directly affected by the collapse and combustion of the impact areas of the attack.

Current sampling results can provide evidence to the low end of exposure of persistent toxics that are not easily cleaned, but not the extent of initial exposure nor exposure to substances that are more subject to degradation and/or re-suspension and escape (e.g., volatiles). Mercury, for instance, was likely to be emitted in the vapor and particulate form. Particulate mercury will persist over a greater length of time. If a

valid signature cannot be demonstrated (as we suspect) all of the sources listed in response to Question #5 above will likely contribute to levels found. Without a valid WTC signature historical perspective or the time line of contamination will be lost.

Matching of the WTC source signature to chemical signatures found in actual environmental samples is limited by the sample types collected during the WTC disaster and available for use in development of the source signature. For example, if only size fractionated bulk particle samples (e.g., < 10 μ or < 2.5 μ) are available for use in development of the WTC source signature then only samples with identical size fractionation can now be used to develop the signature of dust samples found in living and work spaces within affected buildings. Many chemical compounds likely to comprise the WTC source signature (especially combustion by-products formed during the post-9/11 fires) will not be equally distributed amongst all particle sizes. The concentrations of chemicals (weight or mass basis) found on various particle size fractions will vary. This is true for both WTC emissions as well as dusts now residing in living and work spaces over three years after the 9/11 event.

7. What limitations and ramifications, if any, will self-selection and the voluntary nature of participation place on the likelihood of numerically adequate and representative enrollment?

Self-selection prior to sampling will bias the results significantly by underestimating the degree of contamination. Volunteers are more likely to be aware of the WTC risks, and are more likely to have taken preventative and remedial action (e.g., professional cleaning and remediation). Building owners and employers who fear health and cleanup liability are less likely to volunteer. It would be preferable to make a structured random sample of buildings, and then approach selected building owners and tenants. Government-funded cleanup of toxics found is essential for gaining participation. For certain classes of buildings, where a high degree of participation may be possible (e.g., firehouses, schools), it still would make a better sample to approach the school and firehouse after being selected by a statistical method than to base selection on a subset of the class that volunteered. If insurmountable problems compel the original study approach of sampling from among volunteers only, external survey data should be collected to determine the potential extent of self-selection bias.

8. Will over- or under- enrollment of presumed clean or presumed dirty buildings skew results and affect the ability to draw valid conclusions from sampling data results?

Yes, unless the extent of over- or under-enrollment is known and adjusted for. This is one of the likely outcomes if the self-selection or voluntary participation process does not result in a representative population of buildings and no information is available on buildings that were not volunteered. Given the knowledge of contaminant plume locations and the availability of some indoor sampling results from previous years, it

may be possible to stratify the sampling design between presumed cleaned and contaminated buildings. If there is an under-enrollment of one or the other type, provisions should be made to expand that sample set, consistent with other criteria. It is essential that the cleaning history of the building be factored into the consideration of how representative the sample is.

9. Will the "spatially balanced sampling" statistical approach proposed adequately capture the diversity of possible contamination scenarios?

The proposed sampling plan relies on GRTS design, a sampling technique developed for spatially balanced sampling of natural resources [2]. GRTS combines elements of systematic and random sampling in order to achieve a statistically efficient sample that is evenly distributed across a 2-dimensional region. The proposal does not explain why the GRTS technique will be used, or why spatial balance might be desirable in this situation. Although spatial balance might be helpful for assessing average patterns over a large geographic area, a non-spatially balanced approach may be more informative for meeting other study objectives. For example, some degree of spatial clustering of sampled buildings would provide better estimates of within-neighborhood contaminants variability which would be useful for planning Phase II sampling and cleanup. GRTS and other systematic sampling approaches deliberately reduce the likelihood of spatially clustered samples and may therefore work against some study goals. Depending on which objectives are most important, a cluster sample or a simpler stratified random sample [10] may be more appropriate.

Stevens and Olsen's [2] GRTS approach is described to use a two-dimensional spatial grid. In the EPA proposal, stratification by distance from Ground Zero is indicated, presumably with two-dimensional hierarchical spatial grids randomly laid out within each stratum (although the proposal does not describe the latter step). Because the plume and dust had episodic movements of varying durations by elevation and cardinal direction, it may be preferable to use a radial grid that isolates regions of similar cardinal orientation and along urban canyons (wind/plume corridors), or an approach that defines spatially defined regions in regards to proximity to the multiple WTC contamination sources. (This is particularly important for the truck routes used to transfer the WTC waste materials.)

The most difficult task is to assure that each geographic region defined by distance and orientation has an adequate representative sample of building and unit characteristics relevant to penetration, deposition and retention of WTC toxics. This is not addressed in the current proposal, but might be aided by developing a list of all eligible buildings and their known characteristics prior to sampling.

10. Does the proposed spatially balanced sampling frame adequately specify the decision-making criteria, conditions, and methodology to be utilized in determining whether to extend the area for sampling?

The decision-making criteria, conditions and methodology appear to be totally dependent on identification of a "WTC signature", which may or may not be found. Whether or not a signature is found, it is essential to cleanup any unacceptable contamination resulting from the WTC event. As stated in the answer to question # 4, it would be vastly preferable to sample not only all areas impacted by the plume in Phase I, but also to extend the sampling into areas not impacted by the WTC collapse in order to obtain comparable background information. Page 11 of the EPA sampling plan provides only a general statement with regard to data analyses and decision criteria.

11. If significant WTC contamination is found in one part of the building meriting cleanup, should there be sampling and/or cleanup of the rest of the building? Should testing and cleanup be extended to nearby buildings and if large parts of the geographic grids are found to warrant cleanup, should more extensive testing be conducted in adjacent grids?

It is difficult to address this question without data on the extent and variability of WTC contaminants within buildings, neighborhoods, and larger geographic regions. If units within buildings tend to have similar levels of contaminants, then it is sensible to remediate entire buildings based on measurements from a sample of units. The proposed study design will collect measurements from multiple units per building, and will, therefore, generate data that can be used to assess the extent of variability within buildings. However, some cleanup efforts involving ventilation systems may be most practical to implement at the building level, regardless of variation in contamination among units in that building.

If buildings in the same neighborhoods, plume corridor or region are found to have consistent levels of contamination, it may be reasonable to select entire neighborhoods for cleanup or sampling on the basis of sampling results in a few buildings in any neighborhood. The EPA proposal implicitly presupposes that large scale geography will be a strong predictor of contamination, and employs a sampling design that reduces the potential for collection of multiple samples in the same neighborhood. In the absence of any previous evidence that neighborhood contamination levels are well predicted by single buildings in each neighborhood, it might be wise to choose a multilevel sampling design to obtain samples from multiple buildings in some neighborhoods and plume corridors and to specifically address the predictive capability for neighboring buildings in the data analysis.

Ultimately, the question of predicting contamination in buildings that have not been sampled suggests the development of a new study design focused on determining what measurable factors are predictive of current contamination, rather than focusing primarily on the large scale spatial distribution. It is likely that the best predictions of additional buildings for sampling or cleanup would be made by a variety of geographic

and non-geographic factors after a Phase I study designed to determine the effects of all relevant measurable factors.

12. Will absence of a clear commitment in advance to clean indoor spaces found to be contaminated adversely impact rates of participation in a sampling study?

Yes. Owners and employers of buildings and units within buildings that suspect their space to be contaminated will have fears of liability for cleanup and health impacts. This almost certainly will discourage them from participating. Owners and employers that have had professional cleaning and have good insurance are more likely to volunteer to gain assurances of the safety of the building, but not be representative of other buildings.

PROPOSED CONTAMINANTS FOR SAMPLING

13. The proposal identifies five substances to be sampled (asbestos, man-made vitreous fibers, crystalline silica, PAHs, and lead). Is testing for these substances sufficient or are there additional substances for which it would be appropriate to test?

EPA's selection of COPCs was not meant to be a complete set of hazardous substances, but they were selected to serve as a set of health-based indicator chemicals for use in identifying buildings and space within these buildings warranting cleanup [11]. EPA used a set of criteria to restrict the COPCs tested. One such criterion was the frequency of detection. Unfortunately, many of the sampling and analytical methods were inadequate. Areas unlikely to be contaminated, and areas incomparable to inside conditions (e.g., outside ambient air during episodes where the plume was going in the opposite direction) produced an excess of non-detects, resulting in the elimination of many substances found frequently at hazardous levels in many buildings. EPA also eliminated potential COPCs if they were below a benchmark based on proportionate mass of the sampled dust. This criterion eliminated many possible COPCs that may be in hazardous concentrations in indoor environments since the samples [11-13] evaluated were typically from outdoor settled dust dominated by large, heavy mineral fibers and particles (e.g., from cement and gypsum). These larger particles become separated from the finer particulates in the indoor environment. Particulate penetration rates of buildings are higher for small particulates than larger particulates. During typical indoor cleaning, many of the larger particles are removed, leaving behind the smaller airborne particulates to resettle, or adhere to surfaces. These two factors result in a higher concentration of the smaller particulates indoors as compared to outdoors, hence increasing the relative concentration of trace contaminants that are found on smaller particulates owing in part to the larger surface areas characteristic of smaller particles in contrast to equal weights of larger sized particles. Unfortunately, many of the settled dust samples were collected by brushing or scooping up the dust [12,13], which results in the loss of many of the finer invisible

particulates since they become airborne by the process. Alternatively, Micro Vac methods were used with a large pore size (e.g., EPA's method used a filter >1.1 μ) that did not collect the very fine particulates, which were found by others to be in extraordinary high concentrations [8,9].

EPA's elimination of dioxin as a COPC to be sampled also eliminated an indicator of toxic halogenated organic chemicals. Dioxin was identified by the EPA as a WTC COPC. Chlorinated dioxin is semi-volatile, as are PAHs, but is distinguishable as an indicator of combustion with chlorine (e.g., polyvinyl chloride). If dioxin is present in extraordinary amounts, then other toxic organochlorines (many of which are unregulated and do not yet have their toxicity quantified) are likely to be present as well. Cahill [8,9] found a proportionately high amount of chlorine in the fine particulates. Dioxin has been found at levels above health based benchmarks at commercial and government buildings (e.g., 130 Liberty St., 90 Church St., 30 West Broadway). Dioxins should be tested, but the cost of the test is an issue. One possibility would be to use the CALUX assay for dioxin-like activity.

14. Given the preponderance of short, very thin chrysotile fibers in WTC dust, should fibers <than 5 μ in length, with aspect ratios equal to or greater than 3:1, be included in the sampling results and considered in assessments as to whether or not cleaning is warranted?

Short fibers should be sampled and reported. Any assumption that short fibers, less than 5 μ in length, are not hazardous cannot be justified based on the available science [see 14]. There is clearly less evidence for harm to humans from short, thin as compared to long fibers, but there has been less study and less analysis of short, thin fibers. The analytical method of choice for regulatory purposes has been the phase contrast method (PCM), which counts only fibers greater than 5 μm in length and aspect ratios of 3:1. Epidemiology studies therefore have been forced to compare doses in their cohorts only to fibers greater than 5 μm in length. It must be noted that the PCM analytical method was only chosen based on its ability to count fibers, not on any health effect basis [15]. While PCM has been the international regulatory method for analysis, it is not able to detect thin diameter fibers (<0.2 μm in diameter). The evidence suggests that PCM may underestimate exposures and the health risks.

Stanton and Wrench [16] and Stanton et al. [17] found that the longer, thinner fibers were more carcinogenic, but could not identify a precise fiber length that did not demonstrate biological activity. It must be kept in mind that Dr. Stanton has never said long fibers are bad and short fibers are good. In fact, he appreciated that a large number of short fibers, individually of low tumorogenic probability, might be more hazardous than fewer long fibers, individually of high probability [18].

Studies have also found that the majority of asbestos fibers in lung and mesothelial tissues were shorter than 5 μm in length, thus indicating the ability of the shorter fibers to reach the tumor site and remain there. Therefore, their role in the etiology of disease

is implicated [19]. In typical occupational environments fibers shorter than 5 µm in length outnumber longer fibers by a factor of 10 or more [20]. Shorter fibers must be studied in more depth and they should not be disregarded especially when clearance is retarded [21]. Dement and Brown [22] have reviewed the evidence that chrysotile fibers tend to split longitudinally as well as partially dissolve, resulting in shorter fibers within the lung.

In humans the majority of asbestos fibers in mesothelial tissues are shorter than 5 µm in length, thus indicating the ability of the shorter fibers to reach the tumor site and remain there [23]. Fubini [24] argues that, because all asbestos appear nearly equally potent, length and fiber form do not appear influential on the outcome of disease. Fubini makes this conclusion based on work of Boffenta et al. [25] which concludes that the specific type of asbestos is not correlated with lung cancer risk but that industry-specific exposure appears to fit the linear slope best, a finding also supported by Dement and Brown [26]. For mesothelioma, induction was related to the time since first exposure and potency with both industry type and asbestos type [25]. These findings would indicate that fiber alteration in the manufacturing process is an important variable in ability to cause disease. The same may be true for those fibers altered as a result of the WTC event.

The fact that short fibers (< 5 µ in length) have been shown to produce toxic effects in macrophages *in vitro* and to be fibrogenic and tumorigenic in animals *in vivo* [27]; and that they reach the site of mesothelioma development [28] support the inappropriateness of discounting their role in asbestos-related diseases as has been done by the EPA contractors Berman and Crump in their risk assessment index [29]. The data, to date, strengthen the role of short fibers in the etiology of asbestos-related diseases. The indoor sampling plan should utilize an analytical methodology with the sensitivity to include short fibers in addition to those greater than 5 µ in length.

15. Environmental sampling of commercial and government buildings at 130 Liberty Street, 30 West Broadway, and 90 Church Street identified extensive and significantly elevated indoor concentrations of dioxins, mercury, heavy metals, and other contaminants. How can the apparent disparities between these findings in commercial and government buildings and EPA's findings in residential buildings be reconciled? What impact, if any, should these findings have on the sampling proposal?

130 Liberty Street, 30 West Broadway, and 90 Church Street were heavily impacted buildings. They are very close to the site and suffered physical damage leaving the buildings directly exposed. The toxic compounds measured in extraordinarily high amounts are likely to have impacted residences tested by EPA, but to a lesser degree. In part this may be because commercial and government buildings and some residence have HVAC systems, whereas some residences have windows with individual AC systems. In addition, most of the EPA residential sampling took place post-cleanup, not

pre-cleanup, so these results are likely biased towards the lower levels. The residences that elected testing, and not cleanup, were likely to have been cleaner units.

There is also a difference between the concentration of toxics in samples measured in 130 Liberty Street, 30 West Broadway, and 90 Church Street, and the samples measured by Lioy, et al [12] and Offenberg et al [13] that EPA reference. Since the commercial buildings have a much larger sample set [30], the discrepancy may indicate that the Lioy et al. [12] and Offenberg et al. [13] samples are not representative. The Lioy and Offenberg samples were primarily outdoor samples. The bulk samples collected by Lioy and Offenberg were not collected in such a way as to capture all the finer particulates (they were collected by brushing and scooping up the samples, resulting in loss of the finer particulates). The EPA Micro Vac method used a filter that had an efficiency rating above 1.1 µ, which misses a great deal of the smaller particulates, found to be of great importance by other research [8,9] and commercial testing (Horgan, see question 18 below). There are also many differences in sampling and analytical methods used by EPA and their contractors. A great deal of the sampling and analytical methods used in data reported by EPA were not sufficiently sensitive to detect contaminants at background levels.

Mercury was frequently found in high concentrations in commercial buildings, but not in EPA measurements. Some of the discrepancy may be due to EPA testing of mercury in vapor form rather than particulate form. Mercury is more likely to persist in an indoor environment in the particulate form. Mercury was likely produced in the fires in oxide and chloride compounds in the particulate form. In addition commercial buildings are more likely to have fluorescent lights, which would be a source of mercury if the fluorescent tube is broken.

The proposed sampling program must represent a state-of-the-art sampling and analysis effort with adequate QA/QC employed such that the data are fully defensible. The data resulting from this program can be expected to be subjected to a great deal of public attention and must withstand scrutiny applied in a court of law, if necessary.

More importantly, the EPA program design places a great deal of significance on concentrations of COPC/signature compounds found in background buildings in Manhattan. The EPA plan suggests a “trigger” of 3X background in affected buildings as the basis for cleanup. As a result, it is imperative that the background determination phase of the program results in measured concentrations of the COPC/signature parameters (see also answer to question 4). Otherwise, the concept of measured concentrations above threshold, when threshold is “Non-Detect” has no meaning.

16. Has there been adequate attention to the problems of chemical mixtures?

No consideration has been given in the sampling plan to the cumulative effects of the COPCs or signature compounds when individual contaminants are found below published health effects thresholds. More importantly, no consideration has been given

to the complex chemical universe present on these dusts. Many of these compounds are not currently regulated in any fashion and the vast majority have not been adequately assessed for health effects. Some of the organic compounds known to be associated with the dusts (based upon published analytical data) have not been reported previously in the environment. The WTC disaster and ensuing fire was a unique event and accordingly the combustion chemistry in many respects was also unique.

The issue of chemical mixtures is particularly important when dealing with both carcinogenic and non-carcinogenic substances [see 31]. For example, the effects of asbestos exposure and smoking are known to be more than additive (synergistic) [32]. The carcinogenic substances in cigarette smoke include PAHs, which are major WTC contaminants of concern. Lead, mercury, PCBs and dioxins are all neurobehavioral toxicants and, at present, we do not know whether their effects are additive or synergistic. Co-planer PCBs act via the same mechanism as PCDD/Fs, that were not measured adequately in the EPA studies to determine their combined effects. Brominated PBBs and PBDD/Fs were likely to be created in the fires in high quantities (primarily due to PBDE fire retardants) and act like the coplanar PCBs and PCDD/Fs, but were not measured. As a result of the failure to consider mixtures, specific health effects are likely to be underestimated by the benchmark of one set of contaminants. As an indication of how important the federal government considers the issue of chemical mixtures, the Agency for Toxic Substances and Disease Registry has released a series of draft “Interaction Profiles” as a part of their Toxicological Profiles in 2002.

PROPOSED METHODOLOGIES FOR COLLECTION AND ANALYSIS

17. The draft sampling plan proposes a HEPA vacuuming method for sampling asbestos, silica, and MMVF on hard and soft surfaces in residences and workspaces. For sampling those substances in HVAC systems, wipe samples as well as bulk samples are proposed. (The proposed HEPA vacuuming method is described in Attachment 1, which begins on page 22 of the sampling plan, and is then amended on page 30 of the sampling plan.) Is sufficient attention paid in the sampling proposal to obtaining data for both hard surfaces and porous surfaces?

Hard and soft surfaces should be sampled for all target parameters and, in the event a valid signature (or signatures) can be determined, all WTC signature chemicals. The major problem is sampling of surfaces that have been used for three-plus years. This is not going to adequately determine the building contamination. The HEPA method for asbestos is a cause for concern. The 2003 Background study seems to have used the Micro Vac method for sampling of surfaces. The HEPA method will result in collection of excessive amounts of organic and inorganic material which may obscure detection of short chrysotile fibers. For asbestos fiber analyses, a cleanup of the sample by ashing followed by analyses of samples by the 'indirect method' for TEM should be used. No details of this are given in the documents reviewed. The Micro Vac proposed has an efficiency that will not collect particulates less than 1.1 μ, and this is a cause for concern since a great deal of the particulates are less than this size (Horgan, unpublished observations, see answer to question 18).

The plan should identify what hard or soft surfaces will be sampled. If where to sample is left to a field decision, it may skew the results. Sampling categories should include high contact locations and low contact locations (which are most likely to contain the reservoir of materials that may cause recontamination). The analytical methods are not adequately described as would be the case in a typical EPA-sanctioned QAPP prepared for a program of this nature. For example, there are a number of conflicts in the HEPA Vacuuming Method appended to the Plan as Attachment 1.

18. Is the proposed method the best method for collection of contaminants that may remain in carpets, fabric furniture, or drapery more than three years after the collapse of the World Trade Center? If not, can you suggest another method?

The proposed use of the HEPA vacuum technique is appropriate for this application, provided limitations inherent in the method are understood. Regardless of which type of vacuum device is used for dust collection (HEPA or Micro Vac), the resulting samples will not be size fractionated. For comparison to the WTC source sample chemical signature, size fractionation of samples collected in building spaces will likely be needed. This will not be required, however, if an identical WTC chemical signature is determined to exist in equal concentrations in all sizes of particles. This outcome is not likely.

Further, both the HEPA and Micro Vac sample collection techniques will not be effective for collection of very small sized particles (<1 µ). These size particles will likely pass through the filtration media and reenter the room air via the vacuum exhaust stream. There is reason to believe that a large portion of the particles are extremely small in diameter. Several days after the WTC disaster, there were questions about turning on the HVAC System in various facilities. The question was will the normal HVAC filters prevent contamination of the facility? Ambient air samples were collected for total suspended particulate matter (TSP) (NIOSH Method 0500). After the samples were analyzed for TSP, an optical size distribution (OSD) (method in development) was performed to get a rough idea of the size distribution. While the OSD method is not a standardized method, the heavy skewing to the very small particles diameters (Horgan, unpublished) was sufficiently compelling to postpone reactivating the HVAC systems.

TSP	**Optical Size Distribution (microns)**		
mg / m3	% <2.5	% 2.5-10	% >10
0.05	87	13	0
0.07	83	17	1
0.02	86	14	0
0.13	85	14	1
0.08	80	19	1
0.05	79	21	0
0.04	72	28	0
0.35	97	7	0
0.08	86	12	2
0.08	87	13	0
0.11	86	14	0
0.06	88	12	0
0.08	86	14	0
0.04	94	6	0
0.04	95	5	0

Because of this issue, the ASTM has withdrawn its two guidelines for Vac sampling for dust. Please note that ASTM has kept its procedures for Vac sampling for asbestos fibers (see answer to question 24). There is inadequate information on the health effects of small fibers, but concern because of the fact that they will enter deeper into the lungs than longer or thicker fibers. Ellouk and Jaurand [33] review information that concludes that for glass fibers there is greater toxicity of large fibers on a per fiber basis, but equal toxicity of large and small fibers on a per weight basis when tested against growth and viability of cultured tumor cells, while thin fibers were more cytotoxic and transformant than thick fibers on a per weight basis in embryo cells.

Cahill [8,9] found an extraordinary amount of particulates in the range of 0.26-0.09 µ. However, the Amendment to the Vacuum Sampling Method states that there is a 97% capture of particles >1.1 µm. That leaves a lot of particles escaping out the back of the sample collection device. Based upon the current objectives of the plan and end use of the data, it is not clear whether contaminant concentrations by particle size is needed, but this may be a serious problem since these small particles, if inhaled, will enter deep

into the lung. The efficacy of the proposed modified HEPA/Micro Vac method could be compared with ultrasonication, to determine whether the proposed method is adequate as an indicator of the degree the soft surfaces serve as reservoirs for exposure.

Other sample collection techniques would involve direct removal of soft surfaces from the building premises for off-site analytical preparation employing perhaps sonication or direct extraction techniques. These methods are probably too aggressive for the needs of the current sampling program but selective use could provide very valuable information on the collection efficiency of the Micro Vac for smaller particles. Also, it is imperative that particulate-associated heavy metal contamination on porous surfaces be assessed as part of any indoor contamination assessment.

The plan does not address any of the normal QA/QC issues such as blanks, duplicates, replicates and spikes. Things like this will help to determine how well the sample was collected from both a methods and personnel approach.

19. Is the proposed method the best method for the detection of contaminants on hard surfaces in residences and work spaces? Would another vacuum method be better? Or, given the amount of time elapsed, would wipe samples be a preferable method of collection?

The HEPA vacuum sampling technique is appropriate for this application, but only if fine particulates are not target substances. Both hard and soft surfaces should be sampled for all target parameters. For hard surfaces both vacuum and wipe samples should be used. Smoke residues and, in particular, contaminants associated with smaller yet inhaleable particles, will not be sufficiently removed by the proposed HEPA collection technique. The wipe sample will insure these contaminants are included in the total concentrations of target compounds/COPCs present on the sampling surface.

Methods for this study must be related to what is normal background in New York City using the same methods. There also must be sampling in 'inaccessible areas'. Contamination in these areas represents potential for future airborne contamination during cleaning, renovation, etc., as well as providing a better indication of the original level of contamination.

20. The draft sampling plan does not specify a method for collecting samples of lead and PAHs from soft surfaces. Should soft surfaces be sampled for these analytes? If yes, what would be the best method(s) to use? What would be the best methods to use for analyzing such samples?

Soft surfaces such as fabrics are ideal deposition surfaces for particulates and serve as reservoirs for the contaminants. However, the degree to which they constitute a reservoir is unknown, and soft surfaces and carpets are difficult to sample in a quantitative way. Metals and persistent organics can be stable for many years. The

finer particulates, particularly if they have organic constituents, may adsorb and/or absorb to fabric materials. Semi-volatiles, such as PAH's and dioxins would reemit, due to equilibrium partitioning between the solid and vapor phase. The degree of exposure from this process is not well reported, but could be tested and estimated under a variety of conditions (cleaning, moisture, temperature). Particle associated lead and PAHs present in soft surfaces should then be sampled in an identical fashion to what is proposed for asbestos, silica and MMVF. In the present version of the proposed Plan this sampling method is a HEPA vacuum technique. XRF is a useful method for determining metal levels in soil, and perhaps could be applied to carpets and textiles, although at least in the case of mercury the Practical Quantification Limits for the Niton Instruments XRF is 5-10 times greater than typical laboratory detection limits, and therefore may not have adequate sensitivity.

21. Should the proposal's methodology for sampling in HVAC systems be amended to include sampling for deposition in low velocity areas in duct work and at bends in high velocity areas in duct work?

Yes. Low velocity areas such as plenums upstream of heating/cooling coils are good locations for collection of settled particles. The sites are reservoirs for dispersion of contaminants, and the contaminants can be dislodged during irregular disturbances. HVAC systems and in particular the ductwork represent significant "sinks" of dusts and associated contamination. The sampling program employed should place a high priority on this reality.

22. Are the proposed methods for sample collection in HVAC systems the best methods to use? Would other methods be more appropriate?

These are not provided in detail in the draft document. Both hard and soft surfaces will be encountered, so both HEPA and wipe samples would appear appropriate. The proposal does not address the different kinds of duct interiors that will be encountered. Some will be interior lined and some will be exterior lined or unlined, resulting in the same hard vs. soft surface problems. In addition some interior lined HVAC systems have tar-like waterproofing, which will likely contribute significant background concentrations of PAHs at these locations. More attention needs to be paid to documenting the type of system sampled.

The sample plan should designate what parts (intake, blowers, ducts, corners, splits, diffusers, etc.) of the HVAC system should be sampled and what minimum number of samples per sq foot need to be collected. This will also lead to a better correlation when comparing different buildings. It would not be appropriate, for example, to compare results for a building which had 1 sample per 50 foot of ductwork and to results for a building which had one sample per 1,000 sq foot of ductwork.

23. Sampling is proposed on accessible horizontal surfaces such as floors and table tops that would be most likely to result in dust-related exposures from residual WTC dust. However, these are also the surfaces most likely to have been disturbed and/or cleaned since 9/11. Sampling is also proposed for inaccessible locations such as behind or on top of cabinets. Residual WTC dust in these areas is less likely to have been disturbed or cleaned up. However, samples from these inaccessible areas are excluded from cleanup decision-making criteria? Is this exclusion appropriate?

Absolutely not. Since it is likely that most of the particles are of a very small size, most homeowner vacuums are going to suck it up off the floor or out of the couch and blow it right out the back of the vacuum. It then floats around until it settles in an inaccessible location (where it accumulates) or an accessible location (where it is once again sucked up by the vacuum cleaner). The result is less contaminated accessible locations, while a reservoir accumulates in infrequently cleaned and/or inaccessible locations. Consequently results from none of the sampling should be excluded from cleanup decision-making criteria. If it is determined based upon program objectives and statistically based sampling design that samples are to be collected from a particular location then the results should be considered part of the cleanup criteria. Dust samples present in inaccessible locations, like those found in HVAC ducts or ceiling plenums, represent the most significant reservoirs of contaminated dusts available for introduction into residential living space and work space alike. This applies as well to living and work space cleaned previously and viewed as free of dust contamination. These reservoirs must receive the highest priority in the sampling program design. Regularly cleaned hard surfaces will give an indication of regular exposure to dust, but is not the same as a direct measurement of the reservoirs of the sources. If inaccessible areas and/or soft surfaces are found to be contaminated enough to be a source of exposure, they should be cleaned, or, in the case of soft surfaces, removed. Cleaning should target the reservoirs of the toxics. Also samples collected from 'inaccessible areas' are a good indicator or surrogate of past contamination.

24. The analytical methods for asbestos, MMVF and silica collected from hard and soft surfaces by HEPA vacuum have not been defined. What would be the best analytical method to use for such samples when collected from soft surfaces? From hard surfaces?

PCM should not be used. It is too crude of a method to measure the thin chrystotile fibers and the shorter pulverized fibers. TEM is a better alternative. It is essential to see the smallest of fibers. They should report all fibers counted. ASTM has the ASTM D57656-02 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for asbestos mass concentration, and another method for determining asbestos structure. ASTM methods are used when available for the other COPCs, and also should be used here.

PROPOSAL FOR SIGNATURE STUDY

25. Can a WTC signature be scientifically validated?

If a WTC signature does exist (and it may not) it can be scientifically validated. However there are several problems. It may not be practical to achieve the identification of a signature in the required time frame, even if one exists. Explicit quantitative criteria constituting "validation" must be defined prior to collecting data for validation. The primary difficulty is the heterogeneous nature of the contaminants, which results in different transport characteristics in the natural and built environment. This was discussed in detail in the answer to Question 5. The phenomenon also applies to prospective signature compounds: WTC dust and combustion products will become fractionalized by distance, orientation, elevation, building characteristics, interior surfaces and cleaning history. The passage of over three years since the event means that there will be an overlay of new substances that can obscure a WTC pattern.

A successful WTC chemical signature will actually be two (or more) chemical signatures: one associated with building collapse and a second associated with WTC fires. What constitutes a signature may also vary with distance from the site. The best chemical signature for the WTC fires will be comprised of a chemical compound or more likely a series of compounds (likely combustion by-products) that can be determined with a high degree of certainty to be unique to emissions from the WTC. Finding this signature may require extensive chemical analyses of the WTC source sample set currently archived. Further, the analytical procedures needed to accurately measure these compound(s) in dust samples may not be readily available (EPA sanctioned reference methods not available) or may be time-consuming and costly. For example, brominated aromatics may represent one such class of compounds that apparently EPA has already taken into consideration.

Regarding a chemical signature for emissions during the building collapse, the RJ Lee [30] approach represents a viable option. He has found a large suite of compounds frequently found at the close-by, heavily damaged 130 Liberty Street Deutsche building. However it is unlikely that all of these compounds will be found in distant locations. Cahill [8.9] discovered a pattern in very fine airborne suspended particulates one mile away at 50 meters height. While we know that very fine particulates are easily resuspended through human activities, especially sweeping, we do not know much about their cycle in interior spaces, particularly retention in soft surfaces and their ability to serve as a reservoir for future exposure.

EPA is proposing a PAH signature for emissions associated with WTC fires. This may not be valid for buildings exposed to PAHs on a regular basis, for instance buildings near the Holland tunnel are exposed to PAHs from traffic that may overwhelm a PAH signature. Alternatively, areas subject to bright light containing ultraviolet radiation may enhance the degradation of some PAHs, resulting in a "weathered" pattern that could render WTC source PAH signature identification problematic.

Given these difficulties, multiple signatures may need to be developed to account for location-specific factors.

26. Clifford Weisel has written that for a contaminant to be validated as a

surrogate for the possible presence of other contaminants, it must be shown to be a component of all dispersed materials, it must not become separated from other substances during dispersion; there must be consistency in the ratio of the proposed surrogate to other contaminants; and cleaning must be as effective for all contaminants as for the surrogate. Are Weisel's criteria applicable to the signature process?

In the absence of meeting the criteria provided in response to Question #13 these are good criteria. Contaminants have different dispersion and deposition characteristics. Therefore, their relative rates of contamination will vary by distance, elevation, surface type, cleaning, building penetration rates, etc. (See answer to question 5). Other criteria should also be considered in the selection process such as those indicated in response to Question # 13. Criteria stated by EPA in the Sampling Plan (top page 9 and middle page 12) should also be considered. These candidate criteria should be reexamined and the ones substantiated by EPA test data selected for use in the development of the signature for use in the Sampling Plan. There is currently some redundancy and contradiction in the compiled listing of criteria available for consideration from the above sources.

27. Does the proposal for a signature study adequately specify objective criteria for validating or invalidating a signature? Should such objective criteria be determined and stated before or after collection and analysis of data in the signature study? Does the proposal adequately address the issues of specificity and sensitivity for any proposed signature(s)?

The signature study proposed by EPA in its current form lacks specificity and in particular the quantitative criteria needed for a WTC signature to be applied successfully on dusts present in contaminated buildings. At its present stage of development and documentation it is impossible at present to reach any determination of its ability to be conclusive one way or another.

The effort to determine the signature of the WTC fires solely on the PAH profile is risky (destruction by ultraviolet light, many other sources of PAHs). It may require more expensive testing to establish the geographic extent of contamination. The fires had a rich source of halogenated compounds: chlorine (plastics), bromine (flame retardants) and possibly fluorine (Freon). There is evidence that there were three types of fires, the fire before the collapse, high temperature fires and low temperature smoldering fires. The Canadian study [34] identified a possible signature in the predominance of PCB 126, which is produced by combustion and not evaporative sources, as a possible signature. Their team also found evidence of a signature with PCNs and PAHs. The use of brominated compounds as a signature, especially polybrominated diphenyl ethers (PBDEs), should be further explored. There has been little reported on the progress of this effort. Analysis of lead speciation and isotope ratios could result in a signature for lead. For instance, lead monoxide is used in great amounts in computer monitor screens. It is possible that there is a sufficiently unique isotope ratio for this source. Other metals may be found in the very fine particulates, but EPA has not reported sampling and analysis of particles in this size range.

The Canadian study of organic films on windows [34] provided a uniform approach and gave guidance to the degree the contamination decreased with distance. It will be difficult to get as good results this long after the event, but it may provide a supplemental approach.

The signature validation study must be viewed as a work in progress at present. At present EPA does not have the data that can provide the qualitative or quantitative specificity needed to define a successful signature. These will have to be developed and incorporated for use in the sampling plan when available. If a chemical signature can be found then one would certainly want all of those compounds to be a part of the sampling protocol. The best results can be expected when you have a chemical signature of compounds found in the source that are not present in the environment or ubiquitous in the environment under study and not present in the source.

The list of signature compounds suggested also appears to be limited to compounds with known health effects and/or historical regulatory compliance significance. The best signature compounds for WTC dust and smoke may actually be chemicals/elements with little or no health effects, no known health effects or of no prior regulatory interest.

The list of candidate chemical signature compounds should be expanded to include compounds unique to WTC dusts or smoke and not commonly found in the environment. Additional candidates might include brominated semi-volatile organics (already suggested in EPA document undated), phthalates [see 35], strontium perhaps as Celestine [strontium sulfate; see 6], particulate mercury (from the millions of fluorescent lights), cadmium, chromium and/or PCBs. The WTC had large amounts of PBDEs, present as flame retardants hence providing feedstock for production of a wide variety of brominated combustion by-products. According to some documents, the EPA WTC signature task force is investigating brominated compounds as an indicator of WTC contamination. If so, it may also be an indicator of the presence of chlorinated dioxins, which are likely to have also been combustion by-products formed in the 100 days of WTC fires.

28. Can a viable sampling and cleanup plan be developed in the absence of a validated in a unique signature?

Yes. Many buildings in the vicinity of the WTC have already been sampled, cleaned and remediated without a validated signature. A number of these buildings have employed an approach similar to what is presented in the proposed EPA Sampling Plan without the signature qualification feature. EPA has already proposed in the current Sampling Plan that COPC levels found in dust samples will be compared to existing health effects thresholds (if available) and/or compared to pre-established concentrations of COPCs found in New York City background samples. If levels of COPCs found in samples in living/work spaces exceed these established criteria and/or are found to be greater than 3x background levels (or another acceptable factor) then that space should be identified for cleanup. This represents a viable cleanup goal that is already contained in the EPA Sampling Plan.

A good sampling plan that is capable of measuring down to background levels, and is

well structured to include inaccessible areas, building type, elevation, cleaning history, interior surface type should reveal a spatial pattern of contamination and what other factors are important. This may require using multi-variate statistical techniques to make clear the relevant factors that have resulted in persistent contamination.

29. If one or more valid signatures are found, and elevated levels of contaminants are found in multiple residences or workplaces within a building without the presence of the WTC signature, what action, if any, should be taken?

If no evidence of a valid WTC signature exists and the levels of a contaminant such as lead exceed the clean-up criteria, for public health reasons the dusts should still be removed. The problem is deciding who the responsible party is. There is clear evidence of lead in the dust and smoke aerosol that settled east of the site [12, 35, 38], so ruling out the WTC as a source is not easy. The unit nevertheless, out of health concerns, needs to be de-contaminated. If this is indeed a non-WTC source, City, State and Federal agencies should cooperate to identify the responsible party.

30. If no signature is validated and elevated levels of COPCs are found in multiple residences or workplaces within in a building what actions should be taken?

If the elevated levels area health concern, a plan for cleaning and remediation of the building needs to be developed regardless of the source and regardless of the existence or lack thereof of a validated signature. If levels of COPCs found in samples in living/work spaces exceed established cleanup criteria then that space should be identified for cleanup. This should be the course of action regardless of the existence of a valid WTC source signature. The question of responsibility is more difficult than that for the previous question, though, as the COPCs in this case may have originated from the WTC, from another source(s), or from both the WTC collapse and another source(s). In this case there may be a strong presumption of the WTC as the source if Phase I produces evidence the COPCs in question are strongly associated with factors related to contaminant spread from WTC sources. However such evidence will only prove an association, not a definitive attribution. The strength of association of COPCs with distance and other factors, as well as ruling out other potential sources, may help in judging whether or not WTC is likely to have been the source. Responsible parties for all affected space should be identified and directed to clean the property, even if the contamination cannot be conclusively linked to WTC emissions. This is the responsible course of action for protection of the health of New York City residents and workers.

If unit cleanup costs are relatively inexpensive compared to the costs of conducting the research, some researchers consider it an ethical obligation to pay for cleanup of contaminated units at the end of the study. It is worth noting that this would also provide an incentive for participation, thereby improving the overall study design by increasing participation and reducing the potential for selection bias.

31. Is it appropriate to base the whole proposal on an as yet unvalidated "signature"?

No, it is not appropriate to delay cleanup based on the development of a signature. It is appropriate to proceed with the sampling plan but only if there is a commitment to cleanup indoor spaces that are found to have levels of COPCs that exceed those in the background areas even in the eventual absence of a definitive WTC signature.

PROPOSED CRITERIA FOR CLEANUP

32. In the absence of health-based benchmarks for settled dust, EPA has proposed 3X background as the trigger for cleanup of asbestos, MMVF, and silica. Is 3X background an appropriate benchmark for these contaminants in the indoor environment? In HVAC systems?

By there own admission in the Sampling Plan EPA states (pg 10) that this approach of factors above an established background does not "allow for comparison to health-based benchmarks". Ideally the levels of contaminants measured in dust samples should be evaluated by comparison to health based levels. In the absence of health based benchmarks, as is the case for the three parameters above, further justification of the 3X above background criteria is needed. For example, asbestos at 3X background would be of much greater concern than MMVF. Why should one value fit all? Further, it is not clear in the Plan as to what the actual criteria to trigger cleanup are. Will cleanup take place if only one parameter is above its corresponding health based threshold or 3X above background (as appropriate) or is it necessary that all parameters meet these criteria

The crucial issue is how the background levels are determined and reasonable assurances that 3X background is safe. The NCEA review [37] was defective by ascribing upper ranges of measured toxic levels in urban areas as reference background levels, when they were orders of magnitude above the mean. Upper ranges of measured levels in urban environments are usually cases of proximity to local unknown sources. There is no information in the plan as to how background locations were to be collected, nor whether there was to be one background for the whole city, or by boroughs, or by neighborhood (see answer to question 4).

Lastly, there is no consideration given in the plan to cumulative effects if all parameters are below their individual health effects. More importantly no consideration is given to any of the compounds present in the dusts and not measured as part of the proposed sampling program. Health effects levels and acceptable backgrounds even in an urban setting like New York City likely do not exist for the majority of the compounds (especially semi-volatile organics) known to be associated with WTC dusts and smoke. [see 12 and 35].

33. Is the proposed 95% upper confidence limit standard on the mean contaminant level in a building an appropriate methodology to use in determining whether a cleanup of that building's spaces should take place? What, if anything, should be done with regard to cleanup of residences or workplaces in a situation where one or more residences or workplaces in a building are found to exceed WTC contaminant benchmarks but the mean contaminant level for the building as a whole does not satisfy the UCL? Are there other evaluative methods that should be employed in the determination of whether a cleanup is to occur?

The use of an upper confidence limit (UCL) on the mean contaminant level in a building is not justified, and has odd implications which have probably not occurred to the proposal authors. The use of UCLs for EPA hazardous site assessments is based on

the assumption that individuals exposed to hazardous substances at those sites are equally likely to encounter any sampled location, so that their long term average exposures will be well represented by averaging the available measurements. This assumption is probably not true of most buildings in Manhattan, where individuals consistently live or work in the same unit or on the same floor and may never visit most units in that building. If there is any true variability in contamination across units within a building, the UCl will reflect an averaging of exposure across individuals rather than an averaging of concentrations to which any one person might be exposed. To understand the unintended implication of this plan, imagine one small and one large apartment building that have identical distributions of contaminants across units. In this case, the large building has more individuals at risk, but the smaller building is more likely to be selected for cleanup due to a lower sample size producing a large UCL. Clearly the UCL is not a defensible criterion in this context.

Hard accessible surfaces should not be included in the overall mean. They are expected to be fairly clean at this point. The critical question is whether there is a reservoir that will recontaminate an area. For example, if there is a high lead loading in the dust in a ceiling space, and this is averaged out by no lead on the floor and counter top, does this really warrant not cleaning it up? If the ceiling space is a plenum, then cleanup can be justified, if this information is available. Therefore the different sample locations and collection methods should be weighted.

The statistical use of the 95% confidence level is only valid if the sampling was representative and not biased against more highly contaminated areas in the building. However, it is not clear what statistical measure for 'background' this will be compared to? Will the study samples be compared to the mean, median, LCL or UCL of the background samples? The distribution of contaminants in a given building also should be reviewed carefully. For example, it is entirely possible that there are physical reasons for some units or areas receiving more contamination. When a benchmark is exceeded, there should be an investigation for the possible reservoir sources of the contamination, and a review of the adequacy of the sample areas tested. Further testing may be called for. A protocol needs to be developed for this situation.

As a general principle, if dusts collected in an individual residence/apartment or workplace are found to contain COPC/target parameters above threshold levels, that residence or workplace should be cleaned. This should be the practice despite the outcome of statistical analyses done on all samples collected in that building. These locations could be considered “hot spots”. All hot spots should be remediated. This, too, is a common practice in the remediation of hazardous waste sites, which EPA draws reference to for guidance in several places in the proposed sampling plan In many types of adverse environmental exposure, it is the people that fall into the upper tail of probability that are exposed. This exposure is real, and so the contamination needs to be remediated. The reason for the high level of contamination in a particular area needs to be addressed.

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process associated with the WTC Cleanup Program assumed a somewhat modified purpose. … the intent of the COPC selection process was to identify risk-driving chemicals and to establish specific health-based benchmarks for the WTC Cleanup Program." (World Trade Center Indoor Environment Assessment, Response to Peer Review Comments on the Report for Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks, May, 2003 http://www.epa.gov/wtc/response_peer_review.pdf)

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